DOCUMENT RESUME

ED 098 161 SP 008 518

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TITLE	An Investigation of the Intensity of Work Required to Elicit a Training Effect in Women.
INSTITUTION	Texas Woman's Univ., Denton.
PUB DATE	74
NOTE	10p.; Paper presented at the Annual Convention of the American Alliance for Health, Physical Education, and Recreation (Anaheim, California, March 1974)
EDRS PRICE	MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS	Analysis of Variance; *Cardiovascular System; *Exercise (Physiology); *Females; Training
IDENTIFIERS	*Work Intensities

ABSTRACT

Thirty volunteer college women are randomly assigned to different work intensities to determine the threshold of cardiovascular training for young, untrained women. A Quinton 607 Heartrate Controller maintined the specified work intensity on a treadmill. Training consisted of 15 minutes of work, three times per week for one month. Workload was held constant for subgroups. Cardiovascular training effects were determined by using the Balke protocol prior to, miday, and after the training period. Analysis of variance (ANOVA) was the statistical technique employed for repeated measures. Results indicate that there were no significant differences in the variables measured for each of the groups. Programs of walking three times per week do not appear to be sufficiently stressful to induce changes in selected cardiovascular parameters for young women during a one-month period. (A 13-item bibliography is included.) (PD)

AN INVESTIGATION OF THE INTENSITY OF WORK REQUIRED TO ELICIT A TRAINING EFFECT IN WOMEN

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Partially funded by
The Texas Woman's University
Institutional Research Grant #0973

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The value of being able to provide an exercise prescription has been recognized from the earliest records of man. The myths of many cultures include tales of specific prescriptions designed to make a common man into a hero who was able to accomplish exceptional feats of physical performance. Athletic trainers from the time of the earliest Olympic games to the present have tried many regimens with varying degrees of success. Exercise physiologists and physical educators have eagerly joined the search for the "philosopher's stone" for stress adaptation. Overload is the key, but the degree of work necessary to obtain a positive change remains unknown. Every physical parameter appears to have a unique magnitude for adaptation.

In modern societies, where labor saving devices are common, the cardiovascular system has degenerated and is the leading cause of death today. Because of this environmental fact it is obvious that there exists a need to obtain knowledge as to the level of activity required to retard degeneration and/or ameliorate the physical condition of the population. The present study investigated work duration and the intensity required to elicit a training effect upon untrained women. Few studies noted in the literature have considered women, yet the physical characteristics of heart rate, muscular strength, lean body weight and lung capacity are known to differ between the sexes.

Karvonen (1957) found that a heart rate (HR) of 60 per cent of the difference between the resting HR and the maximum was the threshold of cardiovascular conditioning for young Finnish men. Using 80 as a resting HR and 200 as maximum HR this percentage represents a figure of approximately 150 beats per minute (bpm). Other investigators (Corbin, 1969; Shephard, 1968) have found conflicting evidence that questions the concept of a single training threshold. Dotson (1970), Davies (1971), and others (Faria, 1970; Sharkey, 1967) suggest that the concept is applicable. Sharkey (1967) found that 10 minutes of work 3 times per week for 16 sessions at a HR of 150 produced a cardiovascular adaptation to exercise. Roskamm (1967) indicated that a heart rate of approximately 150 bpm produced significant improvement in women when the training program was one-half hour daily. Kilbom (1971) found that female subjects walking three times per week at a rate designed to obtain a HR 50 per cent of maximum did not produce a significant change in oxygen uptake. Edwards (1974) found that daily, fifteen minute training sessions on a treadmill at a rate of 125 bpm produced a significant improvement in the maximum oxygen uptake in four weeks for college women.

Procedure

Twenty-eight volunteer college age women served as subjects for the investigation. All were untrained students who were not physical education majors. The ages of the Ss ranged from 18 to 24. Subjects were randomly assigned to one of five training routines. Groups 1 through 3 worked for 15 minutes three times a week for four weeks at a level required to elicit a HR of 120 bpm, 140 bpm, or 160 bpm respectively. Group 4 worked at an

intensity that elicited a HR of 140 for a duration that equalled the mean work load of the sub-group (Group 1) that worked at 120 bpm for 15 minutes. Group 5 worked at an intensity of 160 bpm until the work equalled that of Group 1. Group 1 did the least severe work of any group (less than one mile) therefore the selection of their load provided the amount of work to be held constant in order to allow intensity to be the primary variable. On the basis of the literature it was assumed that the subjects assigned to the greatest intensity sub-group would increase VO_2 uptake.

Training consisted of walking or running on a Quinton 24-72 treadmill at an elevation of 1 per cent at variable speed sufficient to maintain a HR at the designated level. Intensity of the work was controlled by a Quinton 607 Automatic Heart Rate Controller. The HR Acceleration Control and the Treadmill Acceleration Control were set to insure smooth transitions in speed. Warm-up was considered to be the performance necessary to raise the HR to the specific intensity selected for each group. It should be noted that all but two Ss maintained the selected level of work by walking. Laboratory conditions were kept constant at 27° C. No regulation of outside activity was made.

Recognition of the training effect was determined by positive changes in oxygen uptake at a heart rate of 180. A modified Balke (1952) methodology was employed to measure VO_2 prior to beginning the training program, midway in the one month program, and at the termination point. Appropriate indoctrination in the procedures followed was provided for all subjects. The statistical techniques used were an analysis of variance for repeated measures and the Scheffe Test for subsequent testing.

Results of the Study

The statistical data indicates that no group improved in VO_2 uptake. The VO_2 values obtained for the sample studied were at the lower end of the range of scores reported in the literature (Table 1). The data recorded at the mid-point test indicated a decrement in performance for 24 of the 26 Ss. Twenty Ss did not score above the initial test on the final measure. Although the drop in performance was statistically significant (Table 2), the variation appears to be within normal limits (a range of 4 ml/kg/min) and is not believed to be a methodological error. The Scheffe Test indicated that the difference occurred between the pretest and the mid-point test. Familiarity with the treadmill from the training program might be expected to alleviate anxiety during the early period of the Balke test procedure, but as the stressor increased to require greater work the Ss reactions may have altered allowing an increase in anxiety tp produce the obtained decrement in performance. If the exercise program was an insufficient stressor a training effect should not be expected and the finding of decreased performance would be logical. Note that Ss working at an intensity of 120 bpm obtained a continuous decrement during the study period. Because the Ss were able to walk rather than being forced to run to raise their HR to the prescribed level, the low intensity of the work performed was further illustrated.

The findings of the study would appear to conflict with many of the suppositions accepted by physical educators in the interpolations of the data obtained on men as being applicable to women, as well as one possible interpretation of the findings of Roskamm (1967), and Edwards (1974), obtained with women subjects in studies of intensity and duration.

A program that elicited a HR of 160 bpm for 15 minutes three times per week for four weeks with untrained, young college age women was insufficient to obtain a training effect. The differences in duration of work, length of the training period, intensity of program and fitness level of the subjects probably accounted for the variations by different investigators. The literature suggests the mean maximum HR of moderately trained college age women to be 190+ (Falls and Humphrey, 1971). Assuming a resting HR of 80 for this age group, 60 per cent of the difference would be a HR of approximately 150 which was below the 160 HR intensity level of two of the sub-groups of this study.

An important implication of this study may be that casual walking which is frequently prescribed by physicians or used by some researchers as adequate work should not be expected to develop cardiovascular fitness in untrained young women. Whether a longer period of work or more frequent exercise sessions at these same intensities would positively change the results of the study in unknown, but it is generally accepted that the major factor in the improvement of cardiovascular fitness is intensity not duration (Astrand and Rodahl, 1970). Repetition of the study with more frequent work sessions, a longer study period and greater intensity of work is necessary to clarify the cardiovascular training threshold of college age women.

TABLE ONE

Descriptive Data

	N	$\bar{X}$ Age	$\bar{X}$ Wt.	VO_2 (HR 180)ML/kg/MIN. Pretest	Midtest	Posttest
Group 1 (HR 120) D*	4	19.5	56	34.59	32.59	26.65
Group 2 (HR 140) D	6	19	54	32.12	27.87	33.40
Group 3 (HR 160) D	6	19.6	61	34.52	29.61	32.03
Group 4 (HR 140) I	6	19	61	33.66	27.74	29.06
Group 5 (HR 160) I	6	19.5	62	28.27	25.60	28.11
Total	28	19.32	58.80	32.62	28.62	29.85

*D = Duration of fifteen minutes, I = Intensity

TABLE TWO

ANOVA

Source	df	SS	MS	F
Between				
Groups	4	257.50	64.38	1.07
Subjects	23	1384.53	60.20	
Within				
Trials	2	236.96	118.48	8.25*
Trials X Groups	8	195.75	24.47	1.71
Subjects (G) X Trials	46	657.99	14.35	
Total	83	2734.73		

* = Significant at 0.01 level.

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